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15. Supplementary Notes

16. Abstracts

In response to a request received from a representative of employees per the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, the National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard survey to determine exposures to chromic acid mist at the North American Rockwell, Automotive Division, in Grenada, Mississippi. A study was performed of the plating operation where 25-30 persons were assigned various duties. It was determined that concentrations of chromic acid mist were not toxic at the levels measured during this evaluation and do not constitute a hazard to the health of workers in the Chrome Department.

17. Key Words and Document Analysis. 17a. Descriptors

Hazardous materials, Toxicity, Toxicology, Criteria, Inspection, Standards, Recommendations, Industrial hygiene, Chromium coatings, Electroplating, Mist, Chromic acid, Coating processes, Metal finishing

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HEALTH HAZARD EVALUATION REPORT 72-106-44

HAZARD EVALUATION SERVICES BRANCH

DIVISION OF TECHNICAL SERVICES

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JUNE 1973

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

CINCINNATI, OHIO

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
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HEALTH HAZARD EVALUATION REPORT 72-106
NORTH AMERICAN ROCKWELL, AUTOMOTIVE DIVISION
GRENADA, MISSISSIPPI

JUNE 1973

I. SUMMARY DETERMINATION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education and Welfare, following the receipt of a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposures to chromic acid mist at the North American Rockwell, Automotive Division plant, in Grenada, Mississippi.

NIOSH investigators conducted an observational survey of the associated operation on January 9, 1973. Based on information obtained at that time, it was concluded that appropriate evaluations should, in fact, be made of employee exposures to chromic acid mist.

During the environmental survey, as conducted on January 10-11, 1973, twenty-four (24) air samples were collected to obtain appropriate analytical determinations. The associated health standard promulgated by the U.S. Department of Labor (Federal Register, Part II, §1910.93, Table G-2), 0.1 milligrams of substance per cubic meter of air - mg/M^3 as an acceptable ceiling concentration, was not exceeded except for one sample (0.58 mg/M^3). Three other samples collected at the same location and under similar conditions, indicated a maximum concentration of 0.005 mg/M^3. Results of other samples ranged from <0.001 to 0.006 mg/M^3.

Medical interviews/examinations conducted of employees on January 10-11, 1973, revealed no evidence of permanent injury to the nasal septa or any of the other manifestations associated with chronic chromate toxicity. Interviews did not lead to the identification of any severe sequalae of chromate exposure among workers in the Chrome Department. No cases of death or disability were elicited.

Based upon the results of the environmental/medical study reported above, it was determined that, under conditions found at the time of the survey, concentrations of chromic acid mist were not toxic and do not constitute a hazard to the health of workers in the Chrome Department. Various recommendations have, however, been made to management to assist them in further providing a more desirable working environment for all employees.

Copies of this Summary Determination, as well as the full report of the evaluation, are available upon request from the Hazard Evaluation Services Branch, NIOSH, U.S. Post Office Building, Room 508, 5th and Walnut Streets, Cincinnati, Ohio 45202. Copies of both have been sent to:

a) North American Rockwell, Automotive Division
b) Authorized Representative of Employees
c) U.S. Department of Labor - Region IV

For purposes of informing the approximately thirty-two (32) "affected employees", the employer will promptly "post" the Summary Determination in a prominent place(s), near where affected employees work for a period of thirty (30) calendar days.

II. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education and Welfare, following receipt of a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from an authorized representative of employees regarding exposures to chromic acid mist at the plant operated by North American Rockwell in Grenada, Mississippi.

The North American Rockwell plant is a producer of automotive wheel covers which are initially stamped from rolled stainless steel, and proceed through the chrome plating and balancing processes. Various decorative emblems are then affixed to the finished product.

The plant employs a total of 425 persons, 375 of which are directly involved in production operations. Two (2) shifts work, and during the peak production season (September - February), each employee works approximately forty-eight (48) hours per week. During other months of the year, the work day is shortened so that an overall yearly average of forty-four (44) hours per week is attained. A total of thirty-two (32) persons are employed in the area of the "alleged hazard" (Chrome Department); of these, twenty (20) have more than five (5) years of service at that location.

III. BACKGROUND HAZARD INFORMATION

A. Standards

The Occupational Health Standards, as promulgated by the U. S. Department of Labor (Title 29 Code of Federal Regulations, Chapter XVII, Part 1910, Subpart G, §1910.93, entitled Air Contaminants) applicable to substances of this evaluation are as follows:

Substance	Standard (acceptable ceiling concentration)
Chromic acid	0.1mg/M^3*

*mg/M^3 -- milligrams of substance per cubic meter of air

B. Toxic Effects

It is very difficult to separate the biologic effects of chromic acid from those of other hexavalent or trivalent chromate compounds. Most of the effects attributed to chromic acid have been observed in studies of workers producing chromic acid as opposed to those using said compound.

During one investigation of chrome-plating operations in six (6) plants with a total of 100 workers exposed to chromic acid mist, correlation of chromic acid concentrations in the air with results of physical examinations of workers indicated that continuous daily exposure to concentrations above 0.1 mg/M^3 would be likely to cause injury to the nasal tissues of workers[1].

An increased incidence of corneal congestion and burning of the eyes have been noted among chromate workers. Nasal septal ulceration or actual perforation has been noted in high percentages of workers exposed to chromic acid mist in concentrations ranging from 0.18 to 1.4 mg/M^3. This complication is usually preceded by nasal itching, soreness and epistaxis[2]. These effects on the nasal mucosa generally occur rather quickly after initial exposure to chromates and the majority occur in less than one year. Edema of the uvula and hoarseness due to irritation of the larynx is said to occur in small percentage of chromate workers.

Excessive exposure to the chromate ion in the hexavalent form, such as occurs with chromic acid, results in a rather peculiar and characteristic skin lesion known as the "chrome hole". This is an indolent skin ulcer which characteristically occurs on the hands or other skin surfaces which have come into actual contact with the chromate ion.

The most serious health hazard noted to date in chromate workers has been the high incidence of bronchiogenic carcinoma. The incidence of this almost invariably fatal disease appears to be increased from 10 to 43 times that of the general population. Various series of cases have indicated that there is a latent period prior to the occurrence of the cancer varying from about 10 to nearly 23 years.

IV. HEALTH HAZARD EVALUATION

A. Initial Visit - Observational Survey

The initial observational survey of North American Rockwell, Automotive Division, Grenada, Mississippi, was performed on January 9, 1973, by NIOSH representatives Harry L. Markel, Jr., and James B. Lucas, M.D. The function of the National Institute for Occupational Safety and Health, its relation to Section 20(a) (6) of the Occupational Safety and Health Act of 1970, and the purpose of the visit were explained to

The National Surveillance Network Part I questionnaire was completed with their assistance. The plant is unionized by Local No. 202 - Aluminum Workers International Union, and following the initial conference with management representatives, a meeting was held with Union representatives,

All processes within the Chrome Department are highly automated. After a buffing operation, the wheel covers are transported by conveyor where they are immersed in a cold-dip tank containing a 1.5% solution of sodium hydroxide (NaOH). Following two (2) water rinses, the wheel covers are placed into another cold-dip tank containing a 5% solution of sulfuric acid (H_2SO_4), after which time they receive another rinse prior to immersion in the chromic acid plating solution.

After leaving the electroplating tanks, the wheel covers pass through four (4) more water rinses, the last of which contains boiling water. Following this final rinse, they pass through a drying oven and leave the Chrome Department for further processing.

Various antifoaming agents have been utilized on an experimental basis, but have not been found to be practical. These agents tend to trap nascent hydrogen which is given off during the electroplating process; the hydrogen bubbles are then ignited by the electrodes utilized in the chromic acid tanks. Several small explosions have resulted, and because of this problem, anti-mist and foam additives are currently not employed.

As a result of this initial visit, it was determined that environmental measurements for chromic acid mist were needed to adequately evaluate exposure levels to alleged/potential hazards involved in the Chrome Department operation. Environmental evaluation of employee exposures to sodium hydroxide and sulfuric acid were not deemed necessary because of: (a) the relative weak concentrations and (b) the lack of heat and/or agitation within the dip tanks.

B. Environmental Evaluation

1. Procedure and Methods

Because environmental sampling was to be limited to one substance, the decision was made to complete the evaluation immediately following the observational survey. The follow-up environmental survey was, therefore, conducted by Harry L. Markel, Jr., on January 10-11, 1973, to determine environmental exposures to chromic acid mist.

Four (4) personal breathing-zone and two (2) general area samples were collected during both the morning and afternoon shifts on January 10th and 11th. By the use of MSA Model G battery operated vacuum pumps, air was drawn through the collection filters at 1.7 liters per minute during average sampling periods of 2.5 hours. All samples were collected on 37mm diameter, Type HA millipore filters, mounted in appropriate three-piece cassettes. The general area air sampling devices were placed at specific fixed locations within the working environment, while personal air sampling devices were worn by the employees in order to obtain appropriate breathing-zone samples.

Atomic absorption methods were used for the analysis of chromic acid mist after the filters were ashed with nitric acid (HNO_3), and the solutions made to ten (10) milliliters. Sensitivity of the method is in the range of $0.0003 mg/M^3$.

2. Results and Discussion

A total of twenty-four (24) air samples were collected during the survey, with all analytical determinations being performed by the Western Area Occupational Health Laboratory, NIOSH, Salt Lake City, Utah.

Table I shows the air concentration of chromic acid mist for both the personal breathing-zone and general area air samples collected during the survey of the Chrome Department.

The established standard for chromic acid mist (Federal Register, Part II § 1910.93, Table G-2) promulgated by the U. S. Department of Labor is $0.1 mg/M^3$, based on an acceptable ceiling concentration. From Table I it can be seen that this value was exceeded only in the case of one (1) "questionable" sample which indicated a concentration of $0.58 mg/M^3$. (Note: three other samples, collected at the same location and under similar conditions, indicated a maximum concentration of $0.005 mg/M^3$).

C. Medical Evaluation

1. Procedure and Methods

On January 9, 1973, a preliminary medical survey was conducted by James B. Lucas, M.D., NIOSH physician. Initially, it was determined that there is a small dispensary within the plant with first aid procedures being provided by six (6) individuals who have had Red Cross First Aid Training. There is no nurse or physician employed at the facility. A local physician is employed on a fee-for-service basis, with ill or injured employees going to his office for examination and therapy.

OSHA Form 102, a summary of occupational injuries and illnesses, revealed that of some 641 first aid cases, only twelve (12) instances of skin problems, respiratory illness and heat stress were recorded.

On January 10-11, 1973, all thirty-two (32) individuals who were either employed in the chrome department, or spent part of their work day in that area on a regular basis, were interviewed and given physical examinations. Data was recorded on a previously prepared form (See Appendix A). Special emphasis was placed on the examination of the eyes, nose and throat. A very careful history regarding lung symptomatology was also obtained, and in some instances a physical examination of the chest was performed.

2. Results and Discussion

Nearly all workers were found to be asymptomatic except for occasional individuals who were suffering from acute respiratory infections. A number of workers did remark, however, that they suffered eye irritation when an occasional malfunction of the ventilation system occurs. Sixteen (16), or half of the workers examined, were noted to have varying degrees of nasal mucosal inflammation. In nearly all cases, this was of a minor nature and appeared to be associated with a recent upper respiratory tract infection. This incidence of respiratory infection was not regarded as excessive since the survey was carried out during the peak of the 1972-73 influenza epidemic. No employees were found to have a frankly ulcerated nasal septum, nor were any perforated septa noted.

Two (2) individuals were found to have active chrome ulcers, one being a nearly-healed finger lesion and the other a chrome "hole" on the foot resulting from the wearing of booths saturated with chromate solution. One case of dermatitis, a chronic eczema of the right ankle, was determined to be an idiopathic skin condition and not occupational in origin. A second individual was found to have a bilateral hand dermatitis, and although of occupational origin, it was not possible to determine whether the subsiding dermatitis was one of primary irritation or allergic sensitization. While four (4) other individuals related a past history of chrome ulceration, or other dermatitis, no additional active cases were encountered.

In summary of the medical investigation, there was no evidence of permanent injury to the nasal septa or any of the other manifestations associated with chronic chromate toxicity. Interviews did not lead to the identification of any severe sequalae of chromate exposure among workers in the Chrome Department. No cases of death or disability were elicited.

D. Conclusions

Based on the medical/environmental findings resulting from this survey, it is our conclusion that the alleged hazard to chromic acid mist does not exist, and that the substances found in this plant had no toxic effects in such concentrations as were used or found at the time of this survey.

Since the reported latent period for the development of bronchiogenic carcinoma is longer than the employment period of most employees, it cannot be definitely concluded that some risk of the disease may not exist. However, in view of the almost total absence of upper respiratory tract pathology characteristic of chromate toxicity, the possibility of subsequent pulmonary neoplasia would seem to be extremely remote.

V. RECOMMENDATIONS

1. During the course of the survey it was observed that the large garage-type door adjacent to the Chrome Department, when open, produces a cross-draft and thus reduces the hood efficiency over the chrome plate tank. Efforts should be made to eliminate this condition.

2. Individuals with skin allergies, chronic eye conditions or abnormal respiratory conditions should not be assigned to the Chrome Department where they might be exposed to chromic acid mist.

3. Personal protective equipment is a supplement to, and not a substitute for, safe working conditions, adequate ventilation and intelligent conduct. Where used, dilligence should be exercised to insure repeated inspection, cleaning and replacement when necessary.

4. Leather boots worn by certain employees were, in some cases, observed to be saturated with water and chromate solution. In order to minimize the possible occurrence of chronic lesions, those workers involved in operations where dampness is inevitable should insure that protective rubber boots are worn at all times.

5. Although the use of rubber gloves and aprons is certainly mandatory in operations of this nature, increased efforts should be made to prevent the contamination of the inner surface of the gloves. Consideration might be given to the more frequent exchange of said gloves.

VI. REFERENCES

1. Bloomfield, J. J., Blum, W.: Pub. Health Repts. 43, 230 (1928).

2. Kleinfeld, M., Rosso, A.: Ind. Med. & Surg. 34, 242 (1965).

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VII TABLES

TABLE I
Concentrations of Chromic Acid Mist
North American Rockwell, Grenada, Mississippi
January 10-11, 1973

Date	Sample No.	Operation/Location	Type of Sample	Sample Volume (liters)	Concentration (mg/M^3)*
1-10-73	11281	Rack Loader	(a) P	316	0.003
"	11282	Rack Loader	P	304	0.006
"	11283	Rack Unloader	P	308	0.002
"	11284	Rack Unloader	P	303	0.002
"	11285	Loading Station	(b) GA	306	0.005
"	11286	Unloading Station	GA	291	0.004
"	11287	Rack Loader	P	306	0.005
"	11288	Rack Unloader	P	306	0.003
"	11289	Rack Loader	P	180	0.005
"	11290	Rack Unloader	P	212	0.003
"	11291	Loading Station	GA	313	0.004
"	11292	Unloading Station	GA	306	0.003
1-11-73	11293	Rack Loader	P	158	0.001
"	11294	Rack Unloader	P	204	< 0.001
"	11295	Rack Loader	P	223	0.001
"	11296	Rack Unloader	P	214	0.001
"	11297	**Loading Station	GA	269	0.580
"	11298	Unloading Station	GA	269	< 0.001
"	11299	Rack Loader	P	230	< 0.001
"	11300	Rack Unloader	P	228	< 0.001
"	11301	Rack Unloader	P	221	0.001
"	11302	Rack Loader	P	221	0.006
"	11303	Loading Station	GA	230	< 0.001
"	11304	Unloading Station	GA	235	< 0.001

(a) P= Personal, breathing-zone
(b) GA= General Area
*(mg/M^3)= milligrams of substance per cubic meter of air sampled
**Questionable Sample
< = less than value shown

VIII. APPENDIX